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PLASTIC REINFORCEMENT OF THE WOODEN PINOCCHIO RECOVERY MISSILE

16 JUNE 1953



U. S. NAVAL ORDNANCE LABORATORY
WHITE OAK, MARYLAND

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PLASTIC REINFORCEMENT OF THE WOODEN PINOCCHIO RECOVERY MISSILE

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ABSTRACT: The use of wood as a material for recovery missiles was not successful until the wood was reinforced with a glass cloth laminated plastic material. The plastic reinforced recovery missile, containing critical projectile components, can be fired from an eight-inch gun and recovered for subsequent inspection of the components. The technique involved in reinforcing the wood with plastic is given herein.

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NAVORD Report 2795 reports the methods and materials used in applying glass cloth reinforcement to wooden Pinocchio recovery missiles as carried out at the Naval Ordnance Laboratory under task NOL-Re3f-614-1-53. The information contained in this report is for the use of the Bureau of Ordnance and the Naval Ordnance Laboratory for the application of reinforced plastics where the properties peculiar to these materials are required.

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Captain, USN
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By direction

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PLASTIC REINFORCEMENT OF THE WOODEN PINOCCHIO RECOVERY MISSILE

INTRODUCTION

1. The Naval Ordnance Laboratory in connection with its work on the development of a method for test firing and recovering missile components has developed a wooden missile for this purpose. The use of wood was dictated by a desire for buoyancy, which makes recovery over water possible, as well as for its cheapness and ease of fabrication.

2. It was found that when these wooden missiles were fired, the wood splintered or otherwise cracked and broke up and in all cases recovery was impossible. A way to reinforce these missiles to prevent this loss was, therefore, needed.

3. This report gives information on the method used to successfully reinforce the wood with plastic so that positive recovery and several firings could be expected with each missile.

DESCRIPTION OF METHOD

4. The successfully fired wooden missiles were cylindrical in shape. They were made up of pieces of white pine glued together and turned to the proper size (Figure 1a). One end was solid with an aluminum plate mounted in it. The opposite end had a disc of hard maple glued to it so that wood screws could be used.

5. The initial step in reinforcing these missiles with plastic was to coat the wood with a resin (Appendix I - a). This sealed its surface and prevented air from coming to the surface of the wood during the wrapping operation. It also prevented the resin used in the wrapping operation from being soaked up by the wood. Infra-red heat lamps were used to accelerate the cure of the resin coat.

6. In the second step of the procedure, the blank end of the missile, which is backed up by a solid metal plug when fired, had three layers of glass cloth adhered to it with resin (Appendix I - b). It was found that with the initial missiles, the polyester resin used to laminate this end wrapping did not adhere well to the aluminum plate. It is thought that the lack of adhesion was due to improper cleaning or pre-treatment of the aluminum before application. This trouble was remedied by using an adhesive (Appendix I - b) and working it into the cloth with a spatula. Several successful firings have been carried out with missiles so treated. It is recommended that the aluminum plates in any future missiles be properly cleaned, degreased, and primed to insure good adhesion to the polyester resin. An epoxy type resin may be used in place of the polyester.

7. The cloth for the end wrapping operation was cut so that it fit over the edge of the cylinder and the end of the cylinder was slightly

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recessed so that the cloth would lie flush with it. Cure was effected by use of the infra-red light bank.

8. In order to wrap glass cloth onto the outer surface of these missiles, they were rotated about their axis while being supported from one end (Figure 1a). This was necessary because the end with the metal plate had been covered with glass cloth and resin prior to the wrapping operation. Existing threads within the missile were utilized for support, using an especially made adapter.

9. The wrapping operation, the third step, was carried out in the same manner as is ordinarily done for tube rolling with the missile acting as the mandrel. Where necessary, the cloth (Appendix I - c) was cut to the proper width as it came off of the feed roll. Tension on the cloth was maintained by means of a mechanical brake. The cloth was passed through a pan of resin (Appendix I - c), under and over a series of rollers, to insure complete wetting and finally onto the missile. After rolling on the cloth the outer surface of the missile was covered with cellophane (Figure 1b) and the seam was sealed with cellophane tape. Any trapped air or excess resin was squeezed out using a flexible piece of laboratory hose. In order to make the cellophane tight around the missile it was wiped with a damp rag while turning under an infra-red light bank. This, along with several wipings with a rag soaked in methyl ethyl ketone, caused the cellophane to shrink tightly around the missile. Cure was accelerated by turning the missile four hours under a bank of infra-red heat lamps. The heat from these lamps also helped to keep the cellophane tight until gelation occurred.

DISCUSSION AND CONCLUSIONS

10. The method of reinforcing the Pinocchio wooden recovery missiles with glass cloth, as described, has been found to be feasible. This method sufficiently reinforces the wood so that recovery of missiles so treated is assured even after repeated firings through a smooth bore 8-inch gun. The initial firing is at approximately 4000 feet per second with no spin. After this first firing, splits usually appear in the wood at the open end of the missile. These splits are sealed with epoxy resin. After this no further signs of failure have been noted after refiring at 3200 feet per second.

11. Commercial wrapping of these missiles has been carried out at a cost of approximately \$30 per unit. This cost may be reduced as the technique is improved and greater quantities are desired.

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APPENDIX I

Materials and Sources

a) Resin mix for coating wood:

Marco MR28C	- 80%	Source: Marco Chemicals Inc.
Styrene	- 20%	1711 Elizabeth Ave. W.
		Linden, New Jersey
Catalyst - Lupersol DDM	- 4%	
Accelerator - Marco "E"	- 4%	

b) Resin and Cloth for wrapping end of missile:

Cloth: #128-114 .007 inches thick	Source: United Merchants Ind. Fabrics
	New York, New York
Resin: Marco MR28C	- 90%
Styrene	- 10%
Catalyst - Lupersol DDM	- 4%
Accelerator - Marco "E"	- 4%
Yellow Pigment	- 1%

c) Resin and Cloth for outer wrap:

Cloth: #181-114 .0085 inches thick	Source: United Merchants Ind. Fabrics
Resin: Paraplex P-43	- 80%
Paraplex P-13	- 15%
Styrene	- 5%
Source: Rohm and Haas Company	
	Resinous Products Div.
	Philadelphia, Penn.
Catalyst - Lupersol DDM	- 1%
Accelerator - Nuodex	3/4%
Yellow Pigment	- 1%

d) Source of Lupersol DDM - (60% methyl ethyl ketone peroxide in dimethyl phthalate)

Lucidol Division
Nevadel-Agane Corporation
1740 Military Road
Buffalo 5, New York

e) Source of Nuodex 6% Cobalt Naphthanate

Nuodex Products Company
Elizabeth, New Jersey

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f) Source of Yellow Pigment

Selectron #5518 - Pittsburgh Plate Glass Company
Grant Building
Pittsburgh, Pennsylvania

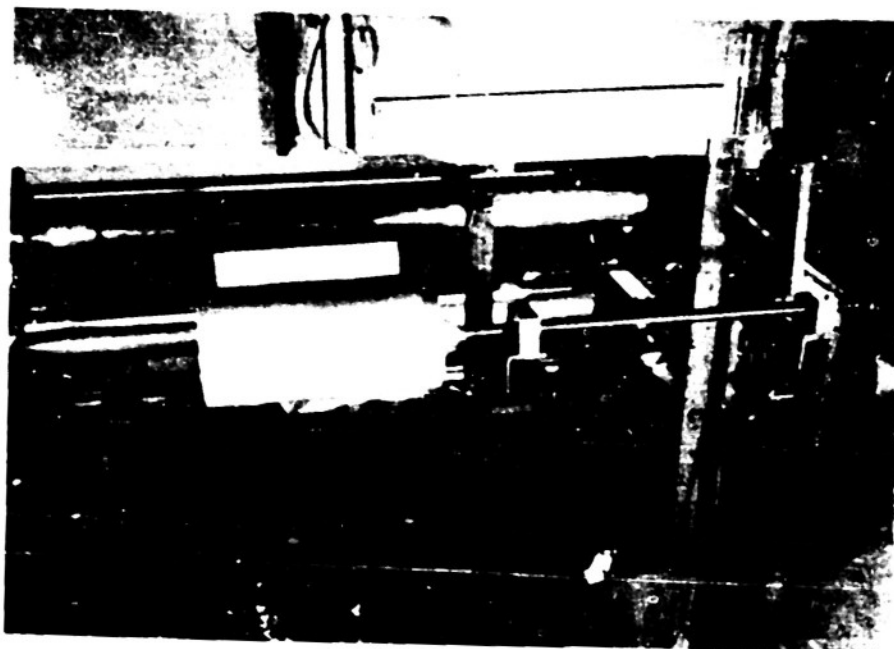
g) Source of Fluorescent Pigment (this has been found to give better
visability than the plain yellow pigment and is available in
several colors)

Switzer Brothers Incorporated
Cleveland, Ohio

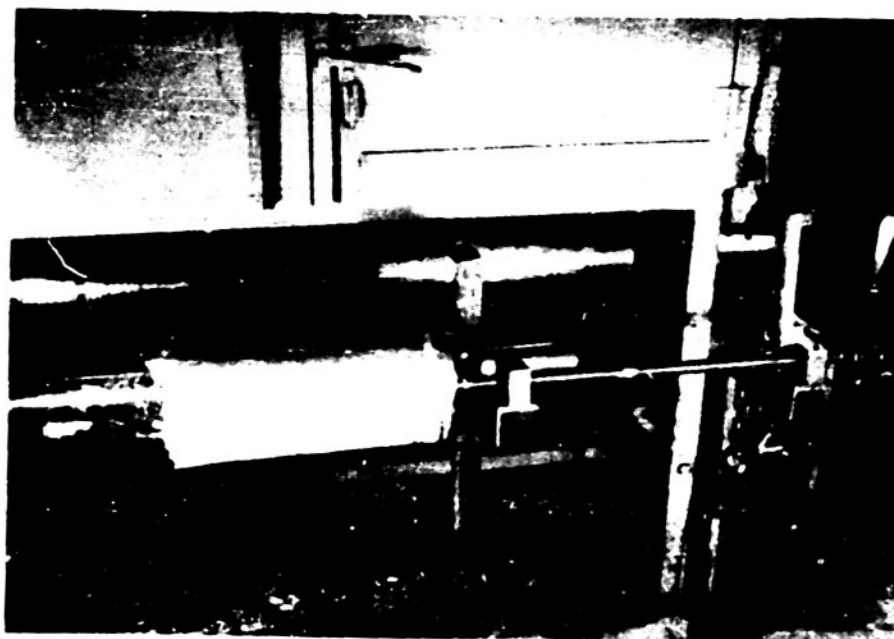
h) Epon Adhesive VI

Shell Chemical Corporation
500 Fifth Avenue
New York, New York

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(a) MISSILE - MOUNTED AND READY FOR WRAPPING



(b) MISSILE - WRAPPED, SHOWING CELLOPHANE ON OUTER SURFACE

FIG. 1

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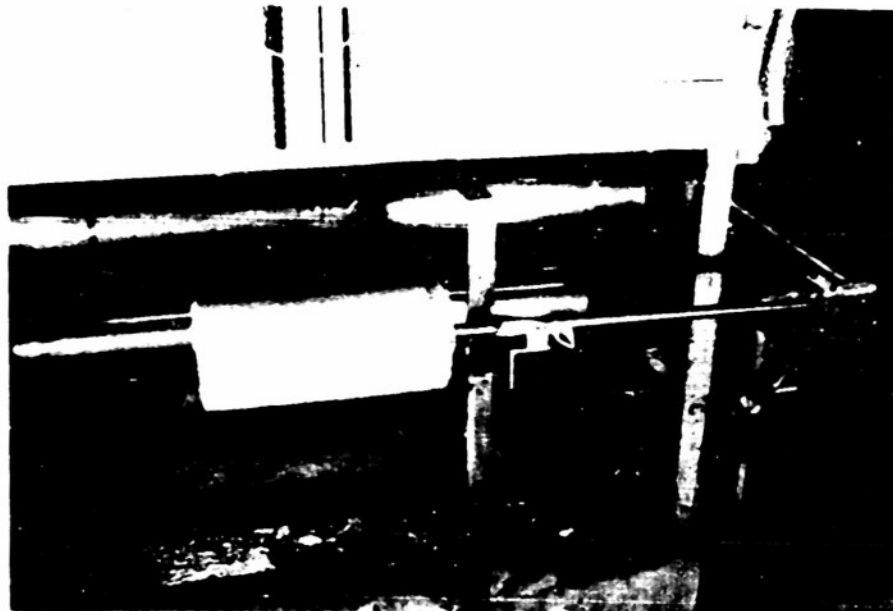
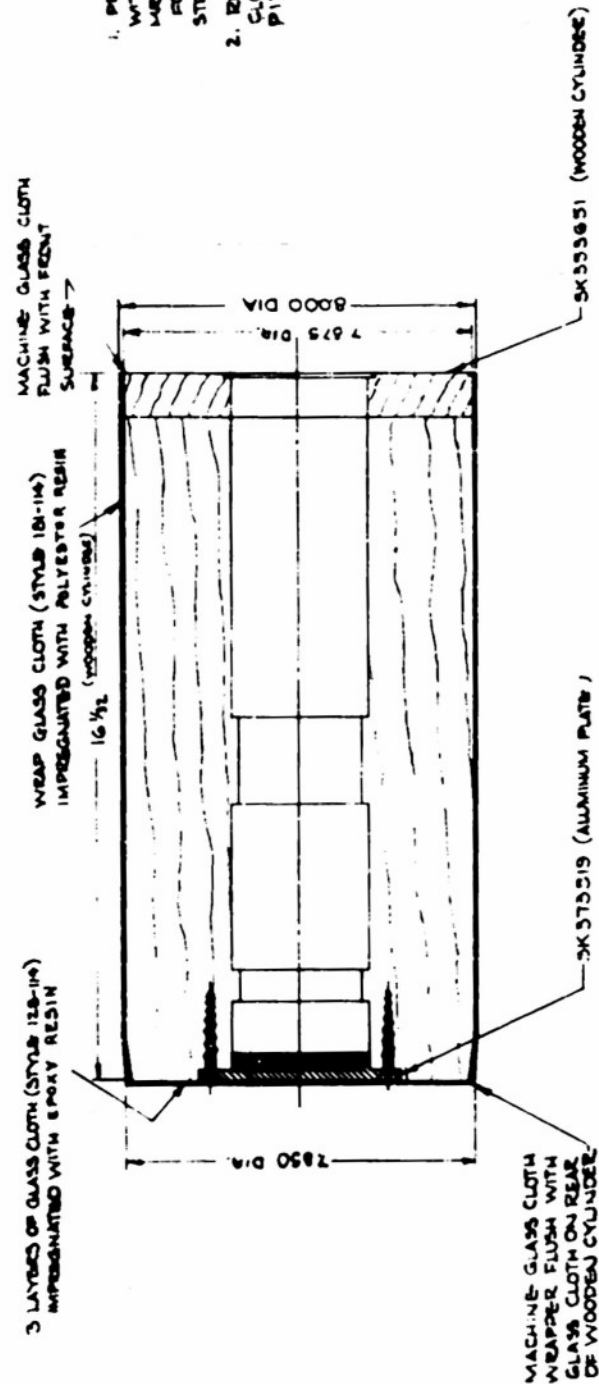


FIG. 2 MISSILE, WRAPPED AND READY FOR MACHINING

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NOTES

1. PRIME OUTSIDE OF WOODEN CYLINDER WITH ONE COAT OF 80/20 MARCO MIE 26C AND STYRENE, PLUS CATALYST. FOLLOW WITH A SECOND COAT OF STRAIGHT MARCO MIE 26C PLUS CATALYST.
2. REBIN FOR IMPREGNATING THE GLASS CLOTH SHOULD BE 80/15/5, PAPER 14 P13 AND STYRENE, PLUS A CATALYST.

FIG. 3 MISSILE - SHOWING GLASS CLOTH WRAPPER

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FIG. 4 MISSILE AFTER SEVERAL FIRINGS

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